In conclusion, it may be remarked that although public opinion was strongly in favour of the importation theory, little if any apprehension of personal contagion was entertained by those in attendance upon and in daily contact with the sick. This indifference to exposure to the supposed contagion of the fever was observable in all classes of society, amongst the lowest as well as the highest. A large number of the inhabitants, it is true, sought safety by flight from the focus of the infection; but amongst the population which remained, "humanity was spared those humiliating and appalling scenes which the medical historian tells us were so constantly presented in the epidemics of the middle ages, of the sick and dying abandoned by their nearest relatives and friends." R. La R.

ART. XVI.—*Chemistry, in its Relations to Physiology and Medicine.* By GEORGE E. DAY, M. A., Cantab., M. D., F. R. S., Professor of Medicine in the University of St. Andrew's. London: H. Baillière, 1860. 8vo. pp. 518.

THE department of science to which the treatise before us relates has, through the labours of its numerous cultivators, become so intimately connected with rational practical medicine as to exercise a very material influence upon the views of those physicians who act in accordance with facts rather than fancies, and, as a consequence, has modified to a considerable extent the practical application of medical principles.

We need not stop now to discuss the opinion above enunciated, as it will, we think, be sufficiently established by what we have to say in detail of Dr. Day's volume; and yet we can scarcely refrain from calling to mind how the students of physiological chemistry have been reviled; how they have had to contend with many of those who, from their eminence and ability, should have opened their minds to the light of truth, but who, alas! have wilfully or ignorantly closed them against the mild persuasions of science. We cannot forget how many prejudices have been called into action against those who brought to the investigation of nature's laws the rigid tests of experimental analysis, and how even the sacred influence of religion was sought to be hurled against those who presumed to employ the principles of chemistry in their inquiries concerning the functional actions of the organism. We do not forget these things, and, remembering them, we find the greater cause for congratulation that, in spite of those obstacles which since the inauguration of the freedom of thought have always been opposed to the progress of truth, the science of physiological chemistry has steadily, though slowly, advanced till it has attained a recognized position among the sciences developed by the reason and the labour of man. True, there are still some who refuse to receive its teachings; there are still some who prefer the vague theories of the past to the facts of the present; but their name is *not* legion, and their voice is *not* mighty, and they grope confusedly in the darkness they love so well, vestiges of an age which, we trust, has passed away forever.

The treatise which we propose to bring before our readers in this notice is divided into three books. Of these the first treats of "*The Organic Substrata of the Animal Body; the Proximate Principles entering into the Composition of the Solids and Fluids of the Organism.*" Although it is essential, for the full understanding of the science of physiological chemistry, that a full acquaintance should be had with the subject-matter which Dr. Day has incorporated into this division of his volume, we do not propose to dwell upon it now. We desire, however, to call attention to a few of the more notable substances which are treated of under the above head; and after having done so, will proceed to consider the more interesting, if not more important, subjects which follow.

In regard to the protein bodies, Dr. Day includes under this head albumen, fibrin, syntonin, casein, globulin, and hæmatocrystallin, as being all that are met with in the animal organism. These substances occur under two chief forms—in solution and coagulated, but are only met with in the animal body in the first-named condition. Most of them may be converted into the insoluble form by heat, by the mineral acids, or by saline solutions; and fibrin assumes this form on being removed with the blood in which it exists from the body.

It is frequently important that the physician should be able to determine the presence or absence of protein bodies; and in order to do this, Millon's test is more generally to be relied on, both on account of its delicacy and certainty. It consists in the employment of a solution of mercury made by dissolving one part of mercury in two of nitric acid of specific gravity 1.41. On the addition of this solution, and raising the temperature of the mixture to from 140° to 212°, an intense and persistent red colour is produced. The only source of error is that the same reaction is given with gelatin and its derivatives.

Dr. Day also refers to the iodine test so much used by histologists in microscopical examinations, but gives no particulars in regard to its preparation and employment. One essential point is that the solution of iodine should not be too strong, or the reaction may be so marked as to interfere with the obtaining of definite results. We have found a good preparation to consist of from two to four grains of iodine and about half the quantity of iodide of potassium to the ounce of water. If the tissue under microscopical examination is subjected to the influence of this fluid, by introducing the latter under the edge of the thin glass cover, a deep brown colour is produced, if the former be of a proteinaceous constitution.

Undoubtedly albumen is to be regarded as the type of the proteinaceous bodies; but, nevertheless, it is not identically the same substance, as it is met with in the white of egg, in the blood, &c. The cause of the modifications which exist would appear to be due to varying proportions of alkaline salts present; for, as it is found in animals, albumen is always in combination with these substances, and consequently never exists in a perfectly pure state.

In regard to the position of *fibrin*, Dr. Day expresses no decided opinion, but appears to regard it as belonging to the class of substances undergoing progressive metamorphosis.

Casein is not only found in milk, but also in the yelk of the egg. Its admixture with albumen was until quite recently regarded as a distinct proteinaceous substance, designated as *vitellin*.

Globulin or *crystallin* resembles albumen in many respects, but differs with it in not coagulating at a temperature lower than 163°, and in one or two other particulars. Globulin is only found in the crystalline lens. The coagulable matter of the red blood-corpuscles is not, as was maintained by Berzelius, identical with it.

Hæmato-crystallin, the proteinaceous substance of the blood above referred to, differs from all the other members of the group, in being crystallizable, and in not being precipitated from its solutions by nitrate of silver, chloride of mercury, chloride of tin, or basic acetate of lead. Its formula has not been established.

The blood-crystals so generally met with in the blood of fish, and some of the mammals, birds, and reptiles, and which, with a little management, can be obtained from most red-blooded animals, consist of this substance or its modifications. The forms of these crystals are exceedingly various, but are constant for the same species of animals.

Lehmann has made the discovery that hæmato-crystallin may be broken up into a nitrogenous substance, and a sugar resembling glucose. This fact has recently been brought forward by several German pathologists in explanation of the pathology of chlorosis, and as an argument to the effect that sugar possesses an important curative influence over this affection. Nothing is known of the origin of hæmato-crystallin.

Passing over a good deal of other interesting matter contained in this division of the work, we come to the second part, which treats of the "*Chemistry of the Animal Juices and Tissues.*"

Dr. Day divides the fluids of the body into the five following groups:—

> "I. The *digestive fluids*, including the saliva, gastric juice, bile, pancreatic fluid, and intestinal juice; and to these we have added the consideration of the intestinal contents.
>
> "II. The *blood and its allies*, including the chyle, the lymph, the blood itself, and the various transudations.
>
> "III. The *fluids connected with generation and development*, including the seminal fluid, the milk, and the fluids of the egg.
>
> "IV. The *excretions of the mucous membrane and the skin*, including mucus, the various sebaceous matters, and the sweat.
>
> "V. The *urine*."

Under the first group the saliva is first considered; and after the chemical properties of the secretion from each gland separately, and of the mixed saliva, have been pointed out, the author takes up the question of their physiology. Dr. Day does not, we think, give sufficient prominence to the experiments of Bernard relative to the uses of the parotid, submaxillary, and sublingual saliva separately. Most of our readers are doubtless acquainted with the results which this physiologist obtained, showing that the secretion of the parotid gland is mainly of use in facilitating mastication, that of the submaxillary in assisting taste, and that of the sublingual in promoting deglutition. The influence of the saliva in causing the conversion of starch into sugar is affirmed by Dr. Day; and though there is no doubt that it does effect this change out of the body, and to some extent in the mouth, we doubt whether Dr. Day does not go too far when he says that it is almost universally admitted that the principal use of the salivary secretion is to promote the conversion of the amylaceous portion of the food into dextrine, sugar, and lactic acid, and thus to promote its absorption. This view is objected to by several of the most eminent physiologists of the world; and though there are some facts which seem to support it, there are others, again, which go to show that the power to effect the change in question is incidental, and of no practical importance whatever. The matter is not settled, and physiologists have still an ample field for research before the true action of the saliva in this respect can be ascertained.

The second section of this part is devoted to the consideration of the *gastric juice*. The chemistry of this secretion is first considered. In regard to the free acid, Dr. Day appears to regard it as being hydrochloric, frequently, but not always, associated with lactic. The view of Blondlot, that the acidity of the gastric juice is due to the presence of acid phosphate of lime, is very properly regarded as untenable. In regard to this point, we think the mass of evidence sustains the opinion of the author, and that the essential acid of the gastric juice is the hydrochloric. We do not deny the general presence of lactic acid, but we think it is derived from the decomposition of the amylaceous and saccharine articles of food, and is not altogether a normal product in this situation.

Dr. Day's section on the *bile* contains all that is positively known on the subject. In regard to the uses of this secretion, he thinks it is mainly employed in the digestion of the fat. This, however, is not proved, and we are still at a loss to designate the exact purposes for which this fluid is required in the economy. It is certainly essential to life, but it is just as certainly unessential to perfect digestion.

In considering the *pancreatic juice*, no mention is made of Corvisart's investigations relative to the action of this fluid on nitrogenous substances. It would appear, also, that Dr. Day sides with the German physiologists in their views regarding its action on fatty matters, views which are in opposition to those held by Bernard.

Owing to the difficulty of obtaining the *intestinal juice* in a state of purity, it has not yet been satisfactorily analyzed. Enough, however, is known of it to warrant us in saying that it is invariably alkaline. The quantity secreted in a given time cannot be accurately ascertained. In its physiological action it resembles both the gastric juice and the pancreatic fluid—dissolving proteinaceous bodies, and converting starch into sugar. It does not possess the emulsifying power in so high a degree as the latter secretion.

Vomited matters, *intestinal gases*, and the *feces* are next brought under consideration, and the latest investigation relative to the composition, &c., of these substances is fully given. With reference to the latter, we find no mention made in the text of the very interesting observations of Dr. Marcet. In a note Dr. Day states that he has refrained from alluding to them because of their comparative incompleteness, and he merely gives some of Dr. Marcet's conclusions. If this is a valid objection, it is certainly applicable to many investigations, the details of which are not omitted in the volume under consideration.

In the next chapter the *blood and its allies* are dwelt upon at length, and the matter which Dr. Day has brought together under this head constitutes, in our opinion, one of the best portions of the book, though we cannot say that any information not already in possession of physiologists is communicated. The views expressed, however, are, in the main, such as are supported by the greatest body of evidence.

The physical characters of the blood are first considered, and then the morphotic constituents are brought under notice.

The existence of a cell-wall to the red corpuscles is affirmed by Dr. Day, and several arguments adduced in support of this view. It appears strange to us that some physiologists should deny so evident a fact. We do not find that any opinion is expressed relative to the origin of these bodies. We have for some time been of the opinion that they were a further stage in the development of the nuclei of the white corpuscles, a view first propounded by Wharton Jones. We have several times seen fully-formed red corpuscles contained in cells in the spleen with white corpuscles and free nuclei, and we believe that it is in this organ, and others of its class, that the change is mainly effected.

In regard to the colourless corpuscle, Dr. Day is of the opinion that it contains, besides its nucleus and granules, an albuminous solution. We find that whenever there is an increase in the number of these bodies, there is an increase in the amount of fibrin in the blood. An intimate relation would therefore appear to exist between the two circumstances. We therefore are rather inclined to adopt the view which was held by Addison, that, instead of albumen, the white corpuscles contain fibrin, and that it is only found in this situation in the blood. There are several other facts which might be brought forward in support of this theory, not the least of which is that in the buffy coat of a clot the white corpuscles may be distinctly seen breaking up and giving exit to a fluid which immediately undergoes fibrillation.

Dr. Day does not in this chapter consider the question of the physiological position of the fibrin. A subject of so much importance could not but have received some elucidation from one of the known abilities and good judgment of our author. We regret, therefore, that he has not given his opinions in detail, and we do so the more from the fact that we are at present engaged in a series of investigations relative to this subject, and should be glad to have the benefit of his views. These investigations are as yet far from complete, but we think they authorize us in expressing the opinion that fibrin belongs to the class of substances produced by the retrograde metamorphosis of the tissues.

The blood is not the same fluid as it is met with in the arteries and veins, or even in the various special vessels of the body. The main difference between venous and arterial blood consists in the fact that the former contains less oxygen and more carbonic acid than the latter. It also, we think, contains more fibrin; at least our own researches lead us to this view, though it is one not held by all physiologists.

Dr. Day holds to the opinion that the menstrual blood contains no fibrin, a view certainly not correct. The reason why menstrual blood does not coagulate is simply owing to the fact that it is generally discharged slowly, and is so acted upon by the secretions of the uterus and vagina that coagulation is prevented. When, however, it is discharged rapidly, it invariably coagulates as does other blood.

The composition of the blood in disease is next noticed, and much matter interesting and important to the physician is given. If physicians would only act upon the facts which are here shown to exist, they would be enabled to treat many diseases much more intelligently than they are now managed. The diseases to which the blood is subject, and the modifications which it undergoes when other parts of the body are abnormally affected, seem scarcely to attract the attention of those who call themselves "practical men."

After considering the "allies" of the blood—the *chyle, lymph,* and *transudations*—Dr. Day passes to the *fluids connected with generation and development.* The other chapters of this section relate to *mucus,* the *urine, pus,* and the *solid tissues.* We are obliged to pass all these over with the simple remark that they are treated in a highly satisfactory manner, and that Dr. Day evinces how thoroughly he is acquainted with the subject considered.

The third book treats of the zoöchemical processes, those actions by which the organism is enabled to live and retain health; and these we propose to consider as briefly as is consistent with a fair detail of the principal facts which may be regarded as established, or supported by strong evidence.

Dr. Day, in the following classification, embraces those substances which are essential to the well-being of the organism, or we may say those substances which enter into the composition of the food of man:—

1. The protein bodies and their derivatives.

2. The fats (or hydrocarbons).
3. The carbo-hydrates—*e. g.* sugar, starch, &c.
4. The mineral constituents of the body.

In regard to this classification, we think it is as complete as any that can at present be made, and one that is far preferable to Liebig's, which, aside from its imperfect character, is altogether wrongly based. That above given is identical with one proposed by the author of this notice several years since. It commences the chapter devoted to the important subject of the *metamorphoses of the tissues.*

After considering the uses of albumen in the economy, and the transformations which it undergoes, Dr. Day passes to the second class—the fats; and as the views which are expressed in his remarks are those which are now generally held by physiologists, we quote a paragraph or two from the volume before us.

> "The second great group includes the fats, whose various uses in the chemistry of the animal body have been already noticed. We have there shown that, in addition to their mechanical uses, they take an active part in the chemistry of digestion, and in all the processes by which the fluid nutrient substances are converted into tissues, and have likewise there and in other passages drawn attention to the fact that no animal cell or fibre is formed independently of the presence of fat. In connection with the importance of fat in the animal economy, we may adduce the well-known fact that the introduction of fat into the body (either as food or medicine) predisposes the organism to the formation of cells; a cell-formation of this kind, however, requires the concurrence of albuminous substances for the construction of the cell-walls. When the organism does not find in the food sufficient materials to form the investing membrane of the fat-cells, it borrows from the muscular fibre the necessary protein substance; and when this source can no longer be drawn from, the fat begins to accumulate in the blood and other fluids. From these facts, and from certain microscopic observations, a theory of cell-formation has been propounded, according to which each cell is primarily formed by the deposition of a thin layer around a minute vesicle of fat. We are not prepared fully to support this apparently simple explanation of the origin of a cell; but this at least is certain, that fat is always to be found in all highly cellular organs (as, for example, the brain and liver), and in all tissues, during the process of their development; pus and certain cancerous growths are rich in fat; the hair-bulbs present an active formation of new cells, and we find them imbedded in the sebaceous glands; the chyle, which always abounds in cells in various stages of formation, always contains much fat; the germ of the egg is surrounded by the fatty yelk-fluid; and numerous fat-globules are found in the muscular and other fœtal tissues." pp. 420–421.

We see, therefore, how much the experience of the present day is against the view of Liebig, that the fats serve only as heat-producing substances, and not as histogenetic materials. The fact is, that no such exclusive classification as that proposed by this physiologist can be based upon truth, as all substances taken as food contribute both to the formation of tissues and the maintenance of the heat of the organism.

The formation of fat in the system is next considered. The weight of evidence is decidedly in favour of the view that fat is not only formed from the carbo-hydrates (starch, sugar, &c.), but also, under certain circumstances, from albuminous bodies. Dr. Day next passes to the metamorphoses of the carbo-hydrates and the mineral substances (through the consideration of which we regret not being able to follow him), and then proceeds to the discussion of the function of *digestion.*

We find nothing new in this chapter, though it is an admirable *résumé* of what is known relative to the important function considered. Dr. Day doubts the correctness of Mialhe's view, that calomel is converted into corrosive sublimate in the stomach through the action of the chlorides of the gastric juice. He bases his objections upon the experiments of Van Oettingen and Buckheim. The only way to definitely settle this question is by direct experiment upon animals with gastric fistulas. We have performed such experiments, and are enabled to say that corrosive sublimate is formed, if means are taken to obtain the secretion of a sufficiency of gastric juice. The availability of the various kinds of food is next considered, and then the function of *respiration* is brought under notice. The several facts which have been ascertained, and the various theories which have been propounded in reference to this process, are fully dwelt upon, and then the twentieth and last chapter, which is devoted to *nutrition*, is reached. In this chapter the nutritive value of the several articles of food is considered, and Dr. Day adduces several arguments showing the necessity which exists for a mixed diet. Another element, frequently overlooked, is the digestibility of the food. Thus, no matter how suitable an article may be, from its chemical composition, to subserve some of the purposes of food, if it is not capable of assimilation it is useless. For example, looking at the composition of gum, it might reasonably be concluded that it would form a valuable heat-producing material, and, from its ready solubility in water, that it would readily be absorbed from the gastro-intestinal mucous membrane; yet when experiments are instituted with reference to this point, it is at once perceived that the substance in question, from its indigestibility, is altogether incapable of acting in any sense as a food. Physicians, however, who disregard the teachings of physiology, and who look upon experiments as useless expenditures of time and labour, continue to injure their patients by giving them gum-water, under the idea that they are sustaining the failing powers of life, and lubricating the mucous coat of an inflamed gastro-intestinal surface. The chapter concludes with a statement of the influence of alcohol and tobacco upon the metamorphoses of tissue, in which the conclusions arrived at several years since by the author of this notice are given in full.

We must now bring our remarks on Dr. Day's treatise to a close. For the physician desirous of knowing what has been done by physiologists, during the last decade, to advance the science of medicine, we cannot recommend a better book than the one before us. Dr. Day is in a position to speak authoritatively upon all the subjects considered, for he has long devoted his attention to them, and few men have done more than he to extend a knowledge of the results which science has given to practical medicine. In perusing his writings, we never lose sight of his thorough honesty, and never fail to perceive how capable he is of giving a correct judgment. We would like to see his work widely distributed among the members of the profession, for we are confident that, were the facts which it contains brought home to the minds of physicians, we would have less empiricism, and might in time see the rise of that system of rational medicine, the advent of which is so much to be desired, but which is still, apparently, a great way off. That it will come, we do not doubt; and our confidence is increased when we reflect that those who labour in the cause are more than the equals, in ability, in eminence, and in numbers, to those who would force upon us the false and dangerous dogmas which spring from the effete systems of vitalism and solidism; and among those who have exerted themselves to break down the false and to erect the true, in the pure spirit of scientific zeal, we must assign a high place to the distinguished Professor of Medicine in the University of St. Andrew's.

W. A. H.